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distance over which the Moon's center must move before beginning of totality, and the velocity being known, the time is also determined.

G. B. Blair.

March, 1907.

INCREASED WATER SUPPLY ON MT. HAMILTON.

The following description of a new pumping plant at Mt. Hamilton is published for its possible interest to other mountain observatories.

Up to the present time the Lick Observatory has obtained its water supply from a small spring (Aquarius) in the north cañon, located about one mile northeast and 325 feet lower than the observatory buildings. The flow from this spring exceeded the consumption in the late winter and early spring months and fell far short of the consumption in the summer and fall months. The storage and distributing reservoirs on Kepler Peak, one half mile east and fifty feet higher than the buildings, supplied the deficiency during the dry season. The needs of the observatory for household and photographic purposes were met by this system, provided the rainfall for the year had been normal and constant care was taken to guard against leaks in the system. In seasons when the rainfall fell below the normal, it was necessary to use the water under short-allowance rules. This has occurred four or five times during the history of the observatory and has been a serious matter, especially as the system of fire protection was impaired just at the time of the year when it was most needed.

Plans were formed two years ago to increase the water supply, based upon the use of a spring in the south cañon, which is 300 feet lower than Aquarius, but whose flow is at least fifteenfold greater than that of Aquarius.

The system of pumping is a somewhat novel one, and I am under great obligations to Mr. J. A. Lighthipe, head of the Engineering Department of the General Electric Company in this district, for calling my attention to it.

The spring is 680 feet lower than the Kepler reservoirs, and the distance between the two, measured on the thirty-degree slope, is 1,400 feet. Catchment reservoirs, capacity 12,000 gallons, have been established at the spring. A two-inch power and supply pipe leads from these reservoirs farther down the steep cañon, a distance of 700 feet on the slope, and

215 feet in altitude. At this lower level an hydraulic motor pump is installed. This is constructed very much like an ordinary steam pump, except that the steam cylinders are replaced by water cylinders, forming the motor. The pipe last described divides into two branches just above the pump. One of these connects with the motor end of the pump and the other with the pumping end. The piston areas for the two motor cylinders are sixfold greater than the areas of the pumping pistons. The large motor pistons, operated by six gallons of water with 215 feet head, enable the small pumping pistons to lift one gallon through the 2,100 feet of two-inch pipe to the Kepler reservoirs, 895 feet in altitude above the pump. In other words, the pump places one gallon in seven in the Kepler reservoirs, the other six gallons doing the work. The simple device of dividing the power pipe just above the pump so as to supply water to the pump-end under a pressure of 215 feet, increases the efficiency of the pumping system to this extent.

The only personal attention required by the pump consists in filling the oil cups once a week. The pump was constructed by the Dow Pumping Engine Works, San Francisco, under the guarantee that it would do the work described.

At the present time the pump is delivering 6,200 gallons per day to the Kepler reservoirs. Our average daily consumption throughout the year is about 1,700 gallons. It is expected that one gallon in seven during the late summer and fall months will deliver about 1,200 gallons per day. With the 200,000 gallons stored in the Kepler reservoirs, and with the Aquarius pumping system available in case of need, it is believed that our annual anxiety as to the water supply will be eliminated. During the dry season the available water supply will be three- or fourfold greater than it has been in the past.

An electric pumping plant is replacing the steam plant at Aquarius.

W. W. CAMPBELL.

MT. HAMILTON, March 25, 1907.

NOTE ON COMET *a* 1907 (GIACOBINI).

The first comet of this year was discovered close to opposition, March 9th, by GIACOBINI, at Nice. From the first three available observations (March 9th, by GIACOBINI, at Nice; March 11th, by RICE, at Washington; March 12th, by FATH,